Exploring Sustainability Literacy through Nature Journaling in School Gardens

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Abstract

Nature journaling in school gardens is a unique way to engage students in the natural world, providing time to notice, wonder, and observe through writing and drawing while engaging in environmental and sustainability learning. With the number of school gardens increasing in the United States, educators can benefit from understanding what students experience while participating in garden-based learning activities so they can adapt their teaching to fit the educational needs of their participants. School garden studies typically focus on measuring academic and health outcomes and nature journaling studies typically focus on educator experiences with one classroom. We facilitated a nature journaling study with four elementary classrooms in a public, Title I school in the desert southwest to explore student experiences while nature journaling in their school garden. Our findings show that nature journaling provides opportunities for students to engage in sustainability literacy by helping them to develop a sense of place in their school garden, inspire environmental stewardship, and practice systems thinking right outside their classrooms.

Keywords: school gardens, nature journaling, sustainability literacy, sense of place, systems thinking

Background

Children are becoming increasingly disconnected from the natural world. With a rise in urbanization and technology use, children today are spending less time outdoors (Louv 2012). Louv (2012) calls this “nature deficit disorder” because this missing connection to nature negatively impacts children in a variety of ways. They are less focused and less healthy; Louv (2012) predicts they may be one of the first generations whose parents will outlive their children. In addition to the individual negative mental and physical effects of being disconnected from nature, this disconnect will likely be detrimental to the long-term sustainability of our planet. According to Richardson et al. (2019, p. 5) “connectedness to nature has been shown to be a much stronger predictor of environmental behavior than other factors, including environmental knowledge.” This is something we must keep in mind during this time when we have far surpassed our planet’s natural resources and are barely meeting the social and economic needs of society (Leach, Raworth, & Rockström 2013). We need our next generation of leaders to be both connected to nature and sustainability literate, and K-12 schools can play an important role in this type of education. Through a qualitative study conducted at an elementary school in Scottsdale, Arizona we explore how student’s experiences while nature journaling in school gardens may be a way to deepen children’s connections with nature and engage in sustainability literacy.

Theoretical Framework

Deepening children’s connections with nature through school garden nature journaling to increase sustainability literacy requires a variety of practices and pedagogies. Though there are many frameworks that conceptualize these practices and pedagogies—e.g. sustainability education, education for sustainability, education for sustainable development, ecological literacy, environmental literacy—Victor Nolet’s definition is often used a framework for outlining goals in K-12 and teacher education (Sterling 2004; United Nations Educational, Scientific and

Cultural Organization 2005; Corcoran, Weaklan, & Wals 2017; Nolet 2009). For Nolet, sustainability literacy is “the ability and disposition to engage in thinking, problem solving, decision making, and actions associated with achieving sustainability,” and “would involve knowledge, skills, and values that inform an individual’s mental models and day-to-day behaviors,” (2009, p. 421). He describes nine themes that may contribute to sustainability literacy: stewardship, respect for limits, systems thinking and interdependence; economic restructuring, social justice and fair distribution, intergenerational perspective, nature as model and teacher, global citizenship, and importance of place (Nolet 2009). These themes are derived from existing theories and empirical work in sustainability and environmental education. This study will focus on stewardship, systems thinking and interdependence, and importance of local place since these themes will likely be most salient to nature journaling in school gardens with elementary-aged students. The other six themes may become more relevant to our study during our data analysis. The three themes are most directly related to nature journaling in school gardens based on our experiences during student interviews and a first glance at several student nature journals.

For Nolet, stewardship as a theme of sustainability literacy “emphasizes a human connection to the natural and physical world, and the importance of establishing an ecological ethic for managing, restoring, and preserving the biological integrity of ecosystems. It implies caring about, and therefore caring for, the environment,” (2009, p. 422). Nature journaling in school gardens is one way to engage students in stewardship because students are spending time in the natural world while participating in an activity that encourages them to reflect on nature spaces. They learn about the environment in their garden through their observations and guidance from their teachers, which likely inspires them to think beyond just their school garden and consider the environment more broadly. Fien (1997) discusses how teachers can help their students develop an “ethic of care” to more deeply engage in advancing sustainability transitions. He cites Noddings (1984, 1992) to describe the caring process, which involves: “(1)

conceptual and emotive understanding, (2) positive regard and respect for the feeling and intrinsic value of other persons, animals, plants and non-living things, recognition of her/his/its/their rights, and (3) the motivation, willingness, and skills to act to protect and enhance these feelings, values, and rights," (p. 439). This caring process seems to align closely with Nolet's (2009) version of stewardship—connecting to nature and both caring about and caring for the environment. Nature journaling, especially with elementary-aged students, can be a first step to developing lifelong environmental stewards.

The systems thinking and interdependence theme of sustainability literacy is about understanding relationships in nature, connections between environmental, economic, and social systems, and how these systems change over time (Nolet 2009, p. 423). Elementary-aged students in the United States may not always have the opportunity to engage in systems thinking as conceptualized by Forrester (1968) and Meadows (2008), but recent curricular frameworks such as Next Generation Science Standards (NGSS) suggest the importance of systems thinking through Crosscutting Concept 4: Systems and System Models (2013). Within the NGSS Framework, this concept includes "defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering" (NGSS 2013, p. 1). Below is a learning progression for systems and system models across K-12 grade levels. We focus on progressions for grades 3-5 and 6-8 in Figure 1.

Figure 1

Next Generation Science Standards "Systems and System Models" Cross-Cutting Concept Learning Progression (2013, p.8)

Progression Across the Grades	Performance Expectation from the NGSS
In grades K-2, students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.	K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
In grades 3-5, students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.	3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
In grades 6-8, students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.	MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
In grades 9-12, students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.	HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

The NGSS (2013) "Systems and System Models" concept is directly aligned with what students can learn through nature journaling in school gardens. School gardens provide opportunities for students to learn about ecological systems through direct experiences with plant and animal life, and during each nature journaling session they are observing and reflecting upon these experiences just outside of their classrooms. For example, they will learn that a plant is not just an individual plant, but part of a larger system of their school garden and local environment.

Importance of local place in sustainability literacy is about knowing about and connecting to where one lives since our understanding of much of the world is situated in the places we live (Nolet 2009). This theme can be thought of more specifically as fostering a sense of place, a

concept explored often in human geography by Relph (1976, 1997), in place-based education by Sobel (2014), and child development and place-making by Chawla (1992). Kudryavtsev et al. (2012) describe existing elements of sense of place from key literature—including place attachment, place dependence, place identity, and place meaning— then propose how experiential and/or instructional educational approaches can affect sense of place. They describe place attachment as how strongly people are attracted to places, and place meaning as the reasons for this attraction (Kudryavtsev et al. 2012, p. 233). They also discuss "ecological place meaning," a dimension of place meaning "reflecting natural elements or ecological features of places," a potential contributor to pro-environmental behavior (Kudryavtsev et al. 2012, p. 235). Vaske and Korbin (2001) describe place dependence as a functional attachment to place and place identity as an emotional attachment to place. Kudryavtsev et al.'s experiential approach is focused on "developing place meaning and strengthening place attachment through direct, frequent, and positive experiences in places." Their instructional approach is focused on "conveying predetermined and developing new place meaning, and strengthening place attachment using discussion, texts, art, and other indirect means," (2012, p. 239). The combination of these elements of fostering a sense of place can be applied to nature journaling in school gardens. Nature journaling in school gardens is both an experiential and instructional learning experience as defined by Kudryavtsev et al. (2012). Students spend time outdoors actively experiencing nature in their school garden while capturing their experience through writing, drawing, and discussion.

Literature Review

Nature Journaling

Nature journaling is an activity that is appropriate for a variety of ages and disciplines. It is usually structured with a prompt and time for participants to observe, write, and draw. Naturalists like Rachel Carson, John Muir, Aldo Leopold, and Henry David Thoreau kept nature

journals to document and reflect upon the natural world. When used in school settings, nature journaling is a way to practice observation skills in nature, or perhaps a school garden which is a form of structured nature, while improving literacy skills in the classroom. It requires few materials and can take as much or as little time as needed. A few books exist on best practices for nature journaling and drawing such as Leslie and Roth's (2003) *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You* and John Muir Laws (2012) *Opening the World through Journaling: Integrating art, science, and language arts*. Leslie and Roth's practitioner-oriented book defines nature journaling as "the regular recording of observations, perceptions, and feelings about the natural world around you," (2003, p. 5). They encourage nature journaling to be done in whatever format works best for the individual. Leslie and Roth (2003) have a very broad definition of nature, so nature journaling can take place anywhere from a densely wooded area without a person in sight to a busy city street. They believe that "the purpose of nature journaling is to study where you live and how you relate to it," a direct connection to Nolet's (2009) themes of systems thinking and interdependence and importance of local place. The John Muir Laws (2012) book introduces field journaling, a stricter approach to nature journaling than Leslie and Roth (2003). Journaling for him is about taking notes, making observations, and developing questions to aid in the scientific inquiry process (Laws 2013). He provides straightforward guidelines for how to engage students in journaling, including how to give feedback on writing and drawing and a variety of lesson plans and activities to inspire educators to bring nature journaling to their students.

A few educators have described their experiences using nature journaling in their classrooms (Cormell & Ivy 2012; Johnson 2014; McMillan & Wilhelm 2007). Cormell & Ivy (2012) explain their action research project to pilot nature journaling as a way to engage students in science learning outdoors instead of only in the classroom. Their students used nature journals for nature observations, drawings and personal reflections. Cormell & Ivy (2012) described how they used Mosesley, Dsjean-Perrotta, and Utley's (2010) Draw-an-Environment

Test Rubric to assess student drawings for change in environmental knowledge. They found that overall, the quality of student journal entries and student knowledge about the environment increased throughout their action research project. Johnson (2014) advocated for broader use of nature journaling in early childhood education. She explained that “the addition of a journal practice to regular outdoor environment exploration allows the child to assimilate their observations and experiences while laying a foundation for literacy education,” (Johnson 2014, p126). However, she did differentiate between early childhood and elementary-aged nature journals, stating that young children have nature journals to document inspiration and wonder while older children have field journals to record observations (Johnson 2014). This explicit differentiation was not present in any of the other articles, though Warkentin (2011, p. 229) did state in their Central Park-based study with university students that “the nature journal is NOT a personal diary of private feelings. It IS your observations, responses and reflections upon the world around you. It is meant to be seen by others,” a nature journaling norm suggested in Leslie and Roth’s (2003) book that Warkentin used to guide the study with her students. Johnson (2014) created guidelines for nature journaling and discussed how support is key for adding outdoor experiences, like nature journaling, to classrooms. McMillan & Wilhelm conducted a study with 67 seventh-grade students to “explore how integrating nature studies with language arts instruction can equip students to engage in skillful readings of literature, their changing selves, nature phenomena, and the world around them” (2007, p. 371). After facilitating a moon observation project with the students over a five-week period, they used ethnographic and reader response theories to analyze student moon scrapbooks, moon journals, along with eight student interviews. McMillan and Wilhelm (2007, p. 375) provided few examples of poetry assignments from the students’ science course that demonstrated that the students were developing “a broader, more authentic, perspective of language usage,” a change that may also be seen through nature journaling.

Of the existing nature journaling literature, McMillan and Wilhelm (2007) is the only study that captures student experiences of elementary-aged students' nature journaling. Two other papers, Arnold (2012) and Warkentin (2011) also capture student experiences from interviews and student artifacts, but their studies were with university students, not children. Arnold (2012) did a study of online multimedia nature journaling with students in an introductory environmental studies course to examine how online journaling can influence time spent outdoors, environmental awareness, and nature perceptions. Arnold (2012) facilitated data collection via surveys and found that students who participated in nature journaling spent more time outdoors, increased awareness of nature, and changed their perceptions of nature, though they did not always see how nature journaling was explicitly connected to the content of their course. Warkentin (2011) used in-person nature journaling with senior undergraduate and graduate geography students in a course called Environmental and Sustainability Education. She integrated nature journaling into the course as a weekly activity so her students could engage in experiential learning as a pedagogical approach, as well as demonstrate place-based learning as a tool for environmental and geographic education. She based her nature journaling norms on Leslie and Roth's *Keeping a Nature Journal* book and Payne and Wattchow's (2009) article about "slow pedagogy of place". She took her students to Central Park once a week where they visited the same place for a significant period of time to record their observations, experiences, and knowledge. Over the course of the semester she wanted her students to experience "quality of time" and "continuity in place," part of the slow pedagogy, which many of them did as evident through their shared work and reflections (Warkentin 2011, p234). These aims align with her teaching objectives, as these students are aspiring environmental and geographic educators who must be attuned to ideas of "place" to most effectively engage their future students. Although McMillan and Wilhelm (2007), Arnold (2012) and Warkentin (2011) share meaningful student experiences, the papers are still primarily focused on teacher experiences and reflections from facilitating nature journaling with their class, not direct student experiences

while journaling. More studies are needed to explore what students are thinking, feeling, observing, and learning while nature journaling.

School Gardens

Nature journaling can be done in a variety of places, from backyards to city streets to national parks. School gardens are a unique place for nature journaling because students can spend time exploring ecosystems while also learning how to care for plant and animal life at their school. These gardens connect students to nature and engage them in science learning in many meaningful, hands-on ways. School gardens have been growing in popularity for the past few decades, as of 2015 there are over 7,000 school gardens in the United States according to the USDA (2015) Farm to School Census. There is no blueprint for how a school garden should be designed and implemented, garden design depends on the local landscape and the students, faculty, staff, administrators, and families that contribute to the school community. This type of learning space provides a combination of experiential learning and outdoor education for students and teachers to incorporate into their classrooms and schools. In a recent issue of *Green Schools Catalyst Quarterly*, authors Elmer-Dewitt and Coleman (2019) discuss how school grounds are used to teach sustainability at a charter school in Chicago. The students study topics like weathering and erosion, fractions, pollinators, biomimicry, and conservation, engaging in NGSS standards while using their school garden (Elmer-Dewitt & Coleman 2019). School gardens are a place to engage students in learning outside of their classroom while addressing academic goals and standards.

There have been a growing number of studies published over the past few decades as the popularity of school gardens has increased. Many of these studies are focused on academic achievement and nutrition (Ozer 2007; Williams and Dixson 2013; Berezowitz et al. 2015) and some suggest that school gardens can be used to teach about systems thinking, interdependence, and sense of place (Cutter-Mackenzie, 2009). Ozer (2007), Williams and

Dixon (2013), and Berezowitz et al. (2015) have synthesized school garden research from the past few decades. Ozer (2007) developed a conceptual framework for the potential effects of school gardens based on her review, including but not limited to nutrition and exercise, school bonding and attachment, academic performance, and conservation and ecological commitment. She found that there are major gaps between research and practice in school gardens, which is concerning because they are gaining so much popularity at such a fast pace. Williams and Dixon (2013) were interested in examining how school gardens achieve academic outcomes to ensure legitimacy in schools. Their review found "overwhelmingly that garden-based learning had a positive impact on students' grades, knowledge, attitudes, and behavior," across all grade levels (Williams & Dixon 2013, p. 225). Berezowitz et al. (2015) were interested in health, specifically fruit and vegetable (FV) consumption, and academic achievement. Their review found that garden interventions may favorably impact both academic performance and FV consumption.

Across the three literature reviews of school gardens, few of the many papers referenced by the authors explored topics like systems thinking, interdependence, and sense of place. Though academic and health effects of school gardens are important to note, gardens are special places in schools that can mean more to students than test scores and trying new foods. They occupy a space between the classroom and the outside world that not all students have access to despite the thousands of school gardens that exist in the United States. Cutter-Mackenzie (2009) describes a very different study than any captured in the three reviews. During the time of her study the Australian government funded a program called Multicultural School Gardens to implement school gardens in low-income schools. The gardens were to be used for growing food and implementing culturally-focused environmental education programs. While the majority, if not all, of the studies from Ozer (2007), Williams and Dixon (2013), and Berezowitz et al. (2015) used methods such as pre-post surveys and traditional experimental design, Cutter-Mackenzie (2009) asked the children to be researchers in addition to conducting

pre-post surveys and performing her own ethnographic field work at the school. The children kept journals, took photographs, and facilitated peer reviews about the Multicultural Garden Program. Through this mixed-methods approach she found that many of the students were able to practice English through the garden, the gardens gave the students time for “slowing down,” and they became spaces for everyday conversations between students, families, and teachers that helped to form a sense of community at the school. This paper’s rich description and study of the garden program as a whole still provides information about health and academic success while building a case for why gardens are so important beyond outcomes that are quantitatively measured. More qualitative, student-centered studies may be helpful in understanding the perspective of students in their involvement with school gardens so educators and practitioners can develop meaningful learning experiences in these spaces.

Research Questions

We address the following research questions in our study:

1. What do students experience while nature journaling in school gardens?
2. What elements of sustainability literacy are evident in students’ nature journals?

Methods

Study Context

Our study was facilitated at an elementary school in the desert Southwest. The school is a public, Title I school with five gardens and a variety of green spaces on their campus. Our research team developed a relationship with educators at the school through another research project on a cooking program hosted at the school by local chefs each week. The gardens are maintained by a volunteer master gardener and his partner. Our team wanted to find a way to engage the students more actively in the garden space and co-developed the idea of a nature journaling program through one of our research team members. The volunteer master gardener and partner donated nature journals to four classes, two third-grade and two sixth-grade,

selected by the principal to pilot the program. The principal chose the four classes because each of the four teachers was interested in testing this new initiative and each had very different backgrounds, teaching styles, and level of teaching experience. Prior to collecting data, the lead investigator met with the teachers a few times to provide them with nature journaling resources and guidance, then we both attended nature journaling sessions to support the teachers as they nature journaled with their students. During the study the teachers were encouraged to take their students outside to the gardens once a week for ten weeks to journal for 20-30 minutes with a prompt that fit the needs of their class at that time. We purposefully encouraged teachers to be very open and flexible with their prompts and classroom nature journaling norms since using their own knowledge of their students to determine the best framework. If asked, we provided them with ideas or guidance, but otherwise tried to attend all nature journaling sessions as support for the students and teachers rather than directors. Each class journaled 10-15 times throughout the study.

This study was embedded within a design-based research approach on nature journaling. The initial study focused on teacher experiences enacting nature journaling. Design-based research is situated between traditional qualitative research and action research (Anderson & Shattuck 2012). We were interested in making a positive change in a community through an intervention while also building theory. We consistently adapted our research process to teacher and student needs. For example, we met with the teachers monthly to check in on how they were doing, how they thought their students were doing, and to provide time and space to reflect on and discuss their experiences.

This study used qualitative methods to assess the students' experiences while nature journaling. New knowledge about the student experience can help to inform educators about best practices for nature journaling and finding ways to connect their students more deeply to nature.

Data Collection

We interviewed 25 students using semi-structured interviews, collected 52 nature journals, and took photos of each class participating in journaling activities to capture the students interacting with the space. Figure 2 includes questions we used during our semi-structured student interviews.

Figure 2

Interview Protocol Questions

	Main Question	Follow-Up Question(s)
1	Tell me about your school.	
2	Tell me about your school garden.	What do you like to do in the garden? Do you visit the garden often? What do you do there? How do you feel about the garden?
3	Ask if you can see their nature journal. Tell me about your nature journal.	How do you feel about your nature journal? What is your favorite part about nature journaling? What have you learned from nature journaling?
4	What is the difference between nature journaling in the garden and nature journaling in your classroom?	
5	How does nature journaling make you feel about your school garden?	
6	How does nature journaling make you feel?	How does it make you feel about the garden? How does it make you feel about your school? How does it make you feel about yourself? school?

We obtained parental consent and child assent from each of the students who were interested in participating in the study. Forms were translated into Spanish for students whose primary language spoken at home is Spanish. Parents and students were made aware that nature journaling would be a part of class activities regardless of study participation and if a student (or parent) did not wish (their child) to participate in the study it would not affect their grades. We obtained consent from 29/35 (82.86%) third-grade students and 27/43 (62.79%) sixth-grade students in the four classes that participated in our study. The remaining students did not return their signed parental consent and/or personal assent forms.

We conducted student interviews during nature journaling sessions. After nature journaling sessions we asked the students again if they were comfortable with us looking at their nature journals, then took photos of the journals. Students were told that if there was a certain page they did not want us to see that they could fold it over and we would not look at it. This was done in addition to the initial consent and assent to ensure students felt comfortable sharing their journals as part of a research study.

Data Analysis

We analyzed interview data to answer the first research question, and nature journals to answer the second research question. Below, we describe our analytic process for each data source. Though the codebooks were similar they were developed separately, so both the analysis and findings will be split into two sections.

Interviews

We used thematic analysis to analyze the 25 student interview transcripts (Braun et al. 2018, Nowell et al. 2017). We developed a preliminary codebook of deductive codes and sub-codes based on concepts from the theoretical framework, literature review, and teacher perspective data. For example, codes such as stewardship, systems thinking and interdependence, and ecological place meaning. We open coded four interview transcripts by hand, then discussed codes and definitions.

After discussing the preliminary codes, we developed an updated codebook using deductive codes from the theory and literature and inductive codes that emerged during preliminary open coding. We removed a few codes including ecological place meaning and stewardship, developed sub-codes for systems thinking, and added one code, biophilia (Kellert & Wilson 1993). Ecological place meaning and stewardship were part of the original theory and literature but were not present in the data. For systems thinking, we reviewed several papers on systems thinking and ecology learning progressions (Keynan et al. 2014; Assaraf & Orion

2005). From these papers the sub-codes a) components and processes, b) relationships, and c) patterns were developed, based on eight emergent characteristics of systems thinking, otherwise known as the Systems Thinking Hierarchy (STH), developed by Assaraf & Orion (2005). We developed the STH when exploring how students conceptualize earth systems using systems thinking. These three sub-codes also aligned with NGSS standards discussed in the theoretical framework so the authors agreed to the addition of these sub-codes. I used the updated codebook to code the remaining interview transcripts by hand, then we discussed emerging trends.

We established a finalized codebook with the codes: sense of place, systems thinking, biophilia, emotions, noticing, sensory experiences, benefits, and barriers. The sense of place, systems thinking, and emotions codes have additional sub-codes. Based on the literature and our discussions, the systems thinking sub-codes were finalized as a) organisms, b) relationships, and c) stability and change. Using the finalized codebook, I coded the interview transcripts using the online coding software Dedoose. Once the transcripts were coded online, we evaluated the code occurrence and co-occurrences across the 25 interviews. I exported all coded excerpts to a Google Sheet and developed a code summary for each code and sub-code, then used the code summaries and code occurrence and co-occurrences to guide the writing of the interview findings.

Nature Journals

How the students described, drew, and engaged with sustainability literacy was often reflective of the prompts provided by their teachers. Prior to beginning thematic analysis for the nature journals, the authors determined what entries to code in each nature journal. Since the teachers were given resources and guidance for journaling, but no required prompts developed by the researchers, some prompts seemed to align with traditional definitions of nature journaling while others were about related topics, such as cooking or sustainability. While these

topics were interesting and engaging for the students and teachers, they did not seem to align to nature journaling as conceptualized in the literature. We developed a definition of nature journaling based on Leslie & Roth's (2003) book and experiences while nature journaling with the students:

> Nature journaling is capturing what you **notice, observe, think, and feel** about the world around you through writing and drawing **while spending time in nature**. The world around you is what you experience with your **senses and emotions**, and nature is an **outdoor space or place that is full of life.**

We emphasize that nature journaling should be about capturing the world around you while spending time in nature. I reviewed each journal and collected the prompts provided by the four different teachers (Figure 3). If a prompt was not explicitly stated, I wrote a prompt that fit what the students wrote based on their experiences participating in journaling on that day or discussions with the teachers. Next, we determined which prompts fit the nature journaling definition and which did not to ensure we were completing analysis on relevant parts of the data. Due to the design-based research nature of the larger study, some of the prompts were co-designed between the research team and the participants. If a co-designed prompt fit the nature journaling definition it was kept as part of the data to analyze. Students participated in 10-15 prompts total per class throughout the study and 5-8 prompts per class were included in this analysis.

Figure 3

Selected Prompts

Class 01	1. Describe and draw what you observe in the garden outside of your classroom. 2. Describe and draw what you observe in the garden outside of the sixth-grade classrooms. 3. Reflect on your experience visiting the butterfly garden. 4. Describe a plant in the garden. How does it make you feel? What does it remind you of? 5. Reflect on your experience visiting the desert tortoise habitat. 6. Write and draw what you see while spending time in the garden. 7. Compare and contrast the two types of milkweed plants we have in the garden. 8. Describe connections between plants and animals in the garden.
Class 02	1. Write about how you have seen the garden change over the past few months. 2. Write about how the fig tree has changed over the past few months. 3. Write about what you notice in the garden today. 4. Based on the quote from *The Littles:* find a tiny masterpiece in the garden. 5. Write about the rain today. 6. Compare and contrast two plants in the garden. How are they the same? How are they different? 7. Describe what you notice in the tortoise habitat. 8. Describe how you feel when you are in the garden.
Class 03	1. When you go outside, which of your five senses are you most thankful for? 2. Think back to all your experiences with nature. Make a list if you'd like. Choose your favorite experience and write a detailed narrative. 3. Where is your favorite place to sit in the garden and why? 4. Spend 5 minutes observing the world around you. Write about what you notice the most. 5. Do you consider yourself a nature lover? Why or why not?
Class 04	1. What types of clouds do you see outside? 2. How are you doing today? Pick a plant that describes how you are feeling or that you connect with. 3. What do you notice, observe, and wonder about in the garden? 4. Draw a picture of something in the garden that matters to you, then write about why it matters to you. 5. Name and draw a picture of you and your ladybug. Describe where you are releasing your ladybug and why.

Thematic analysis was used to analyze the 52 student nature journals (Braun et al. 2018, Nowell et al. 2017). We took photos of each page of consented nature journals and combined the photos into PDF documents that were printed for the analysis. Written text and

drawings were included in the analysis. We open-coded four journals, one per class by hand. I open-coded four additional journals, two per class. I chose the journals that had a response for each prompt since some journals were more complete than others. We coded using finalized codes from the interview data, deductive codes from the theoretical framework and literature review, and any codes that emerged during this stage of the analysis. For example, we kept codes and sub-codes such as sense of place, systems thinking, and stewardship because they align with Nolet's (2009) sustainability literacy, then added an emergent code called ecological knowledge. Ecological knowledge included two sub-codes, learning content and sensory experiences. We were interested in capturing how the students were learning about the garden and thought it may be a cycle of learning content in class then experiencing ecological processes in the garden. After open coding four journals, we discussed our coding results. I coded all journals using the initial codebook by hand because we did not have any edits to the codebook.

After coding all journals by hand, we met to develop an updated codebook using deductive codes from the theory and literature and inductive codes that emerged during open and initial coding. We expanded on codes such as ecological knowledge because all students were encouraged to notice, observe, and wonder using their five senses in the garden. This is an integral part of nature journaling. We were most interested in what specifically the students were noticing, observing, wondering, and sensing, which seemed to fit best under the existing code systems thinking and its sub-codes. For example, if a student drew a picture of a leaf, it would be coded as systems thinking and organism, as well as whatever elements the student specifically noticed about the leaf. Some sub-codes of the organism code included color, shape, texture, and veins. Additionally, segments initially coded with the systems thinking sub-code stability and change were re-coded with the systems thinking sub-code organisms. Many of the instances of stability and change were focused on students describing or drawing plant life

cycles, which more closely related to organisms than the NGSS (2013) framework. Using the updated codebook, I re-coded all journals by hand.

After coding the data using the updated codebook, we met to discuss any further edits to the codebook. We agreed to finalize the updated codebook and were ready to add the codes to Dedoose. The finalized codes were sense of place, systems thinking, writing style, stewardship, emotions, and biophilia. However, while Dedoose was useful for the interviews, it was not useful for the nature journals. Researchers can code segments as photos on Dedoose but cannot export the text from the segments saved as photos, so after entering some of the nature journal codes online, we decided to transfer the codes to a Google Sheet so the data would be easier to transfer and understand. I reviewed all the nature journals again while inputting coded segments and photo descriptions into a Google Sheet. I then developed code summaries for each class since the prompts varied greatly per class. The code summaries were used to guide the writing of the nature journaling findings.

Findings

Students' Experiences: Developing a Sense of Place

To address our first research question—what are students experiencing while nature journaling in their school garden—we found that students' experiences were situated in developing a sense of place. Sense of place includes place attachment, feeling connected to place, and place meaning, creating meaning that facilitates that connection (Kudryavtsev et al. 2012). For the students, place attachment was described through their feelings of biophilia, the students' innate connection and affiliation to nature, the positive and negative experiences they had while nature journaling in their school garden, and through the emotions they shared about the garden during their interviews. Place meaning was described through what they noticed, their sensory experiences, and their engagement in elements of systems thinking.

Place Attachment

Students described their place attachment by talking about experiences that demonstrated biophilia, student experiences, and student emotions described during semi-structured interviews. A majority of the students mentioned feeling a strong connection to nature and their school garden, which we understood as an expression of biophilia. Students typically described enjoying time outside around the plants, seeing the different colors in the garden, and being in awe of the garden's beauty. When asked about what they have learned from nature journaling, one sixth-grade student shared:

> "You get inspired out here...you see things, you like them and you write about them...different than your usual surroundings in the classroom, you're used to everything, you don't usually find anything different...but when you're in nature, everything is always changing...plants are always growing, the wind is always blowing, it's just gorgeous and I think that it's really inspiring."

This student's strong connection to the natural world exemplifies how many other students felt while spending time nature journaling in their school garden. Biophilia was often described alongside positive emotions, and a few times with sensory experiences.

During the interviews, students were asked to describe what they liked and did not like about the garden and nature journaling. Almost all the students described positive thoughts and experiences about nature journaling or spending time in the garden. Many of them discussed how nature journaling is peaceful and inspiring, provided them with more time to be outside, gave them a relaxing break during the day, and helped them practice writing. When asked about their thoughts about nature journaling, one sixth-grade student shared:

> "I think that every school should do it. Like I said, it helps you get out of the classroom, helps you learn things, and helps you experience things being able to touch, feel, taste things outside of your classroom."

Many students felt similarly about their experiences. There were only a few instances of negative experiences during nature journaling shared by the students. These negative experiences were related to heat, bugs, space, and time.

Figure 4

Positive Emotions Described by Students

Positive Emotion	Good	Peaceful	Relaxing	Calm	Happy	Inspired	Appreciative/ Proud
Code Occurrence	18	9	7	6	19	5	4
Number of 3rd Grade Participants	6	2	0	3	5	1	2
Number of 6th Grade Participants	7	7	5	4	7	2	0

There were many examples of positive emotions described by the students when asked how they feel about their school garden and how they feel about their nature journals. Students expressed feeling happy, good, peaceful, relaxed, calm, inspired and proud while nature journaling in their school garden. Figure 4 shows how many times the students used these words to describe their emotions in their interviews. Third and sixth-grade students voiced feeling good, calm, happy, and inspired similar numbers of times. Only sixth-grade students described the garden as relaxing, and only third-grade students described feeling appreciative or proud. When asked how nature journaling makes them feel, one sixth-grade student shared:

> "... it makes me stress free, it makes me feel like I'm a bird, like I can just go anywhere I want…"

This sentiments of peace and calm were shared by several students. Another student conveyed how they felt better after writing in their journal because they were able to express how they feel. In general, students described positive emotions when discussing being around

the plants, spending time outside, taking a break, expressing themselves, getting to write, and having more opportunities compared to other students. There were only a few instances of negative emotions. These negative emotions ranged from being scared of bees to feeling "insignificant compared to all the things that are out there."

Place Meaning

While place attachment is the feeling of connection to a place, place meaning is what facilitates that feelings of connection. Students described what the garden meant to them in a variety of ways. During their interviews, they conveyed what they noticed, their sensory experiences, and their engagement with elements of systems thinking. A third-grade student shared an example of both place attachment and place meaning when asked to tell us about their school garden:

> "The school garden is...we have three gardens. My favorite one is probably the sixth-grade garden...it's just really beautiful because there's a lot of trees and there's fruits and vegetables and cabbage. And it has a lot of scent to it."

The third-grade student says the sixth-grade garden is their favorite, describing place attachment, and it is their favorite because of the plants and the way it smells, describing place meaning. Many of the students told us about similar experiences noticing specific parts of the garden and using their senses to engage with the garden. When explaining what they noticed, students would often list and describe the different types of plants in the garden. Students would point out their favorite plants and spaces in the garden, note the colors and textures of plants, and even describe how they enjoy seeing how the "sun shines over nature." One student described a flower as a "face flower" because the flower looks like it has eyes and a mustache. Another student described liking a specific type of flower because its polka dots look like a galaxy. Instances of noticing sometimes occurred with instances of biophilia and systems

thinking, likely when students began connecting the details of the garden to ecological processes.

Sensory experiences were described by just over half of the students. These included instances such as enjoying the different scents of plants, hearing the breeze “rustle through leaves”, tasting kumquats and other edible plants, feeling the sunshine, and being able to walk around and observe while nature journaling. The students were able to use all five senses while nature journaling, though not all students described using all five senses. One student in a third-grade class described nature journaling on a foggy day. They shared how it was a “very special day” because felt like they were “in a cloud,” a rare sensory experience for students in Arizona.

While details noticed through sensory experiences were described by both third and sixth-grade students, elements of systems thinking were primarily discussed by third-grade students. Students typically used systems thinking when discussing ecosystems. Instances of noticing and systems thinking sometimes co-occurred during student interviews. To differentiate between the two, systems thinking was coded in references to ecosystems while noticing was coded in reference to students listing parts of the garden. Systems thinking could be categorized by a) organisms, b) relationships , and/or c) stability and change (Keynan et al. 2014; Assaraf & Orion 2005; NGSS 2013), Though there were three categories of systems thinking based on the literature, the students often described at least two categories at once. For example, one student discussed how they enjoyed writing about how plants react to the weather. The student stated:

“when it’s really hot, some of the plants die, and some of them grow even more.”

In this example, the student used all three categories. They described the plants as organisms, the relationship between weather and the plants, and how hot weather facilitates change because some plants die and some grow more. Another student shared:

> “I like the garden because there's bees, and I like when the bees are around because bees spread the pollen and then that's how we get honey.”

This student used categories a) and b) by describing the bees as the organisms and the relationships between bees, pollinators, and honey consumed by humans.

Engaging in Sustainability Literacy

To address our second research question — what elements of sustainability literacy are present in students' nature journals — we focused on the three elements of Nolet's (2009) sustainability literacy: importance of local place, systems thinking and interdependence, and stewardship. While the experiences the students shared about nature journaling in their school garden are situated in developing a sense of place, their nature journals provided a space for the students to write and draw about their interactions with the natural world and reflect on their emotional experiences over the course of the nature journaling initiative. The elements of sustainability literacy present in the nature journals often overlapped with the codes that emerged from the interviews with the students about their experiences.

Sense of Place

Students' sense of place was evident in the journals of three of the four classes that participated in our study. Students described their sense of place in terms of attachment, how they felt while nature journaling, and meaning, what specific parts of the garden meant to them, related to their school garden. The students in one of the third-grade classes wrote broadly about how much they liked the colors and plants in the garden, especially flowers. When asked how they feel while they are in the garden, one third-grade student wrote:

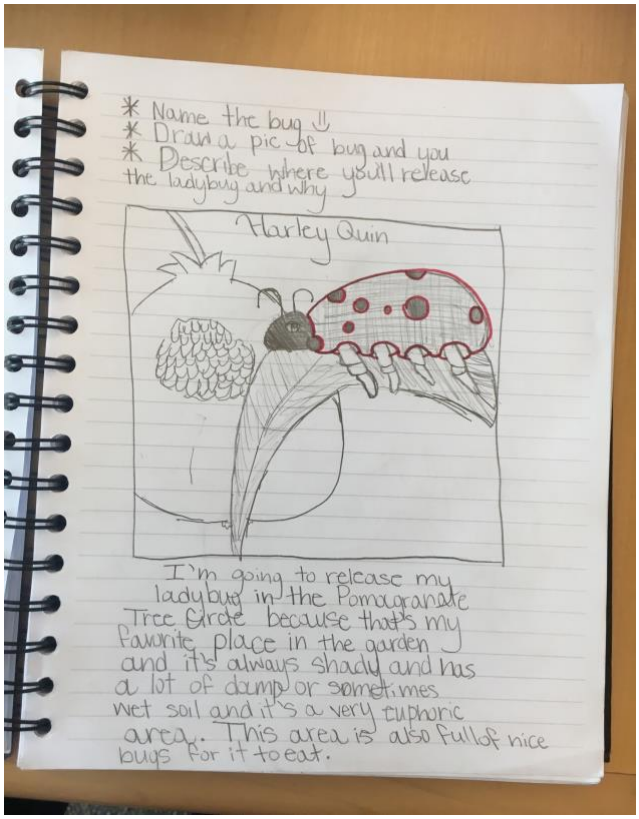
> "When I am outside I feel comfortable and happy. When I am outside I feel peaceful because I like all the colors and shades of green...when I am in class doing my work it feels good just knowing I have a big and beautiful garden outside my classroom."

Students in one sixth-grade class discussed specific places they liked to sit in the garden, a prompt provided by their teacher. Many students discussed how they liked being in the garden because it is peaceful, shady, and they like being around the plants. Students in the

other sixth-grade class also discussed specific places they were attached to in the garden, such as the “pomegranate circle” in the middle of the garden directly outside their classroom.

Figure 5

Ladybug release in pomegranate circle



Sixth-grade students discussed specific plants they felt connected to, a prompt provided by their teacher (Figure 3, Class 4, Prompt 2). Often, the feeling of connection was related to their place attachment or place meaning to the garden or their school. One student discussed how a certain plant smell *reminded them of positive memories from school:*

> "...this plant matters to me because when I think of this school white fluffy rosemary comes to mind, that delicious maple syrup smell.”

For the three classes that described experiencing a sense of place in the garden, many of the student’s written responses and drawings included biophilia. When asked to discuss their

favorite place in the garden, a sixth-grade student wrote the following about her love of the plants and animals in the garden:

> "I don't really have a favorite place, but I like to sit next to the strawberries, peppers, and the plants where the caterpillars are and the ladybugs are. I love ladybugs and caterpillars, they're so cute! I like sitting next to the strawberries because I like how they turn out, I like seeing how they are doing, I just like strawberries..."

A third-grader shared similar experiences of biophilia related to the fig tree directly outside of their classroom. When asked to observe how the fig tree has changed over time, the student wrote:

> "This tree is my favorite tree in the whole garden and it is so pretty to look at and fun to fan yourself with its big leaves."

This student describes her love for the fig tree and associates it with spending time outside in the school garden, an example of her place meaning in the garden. While students engaged in sense of place through writing and drawing in their nature journals by describing what specific places they are attached to and associate meaning with, they also wrote and drew about specific organisms that captured their attention.

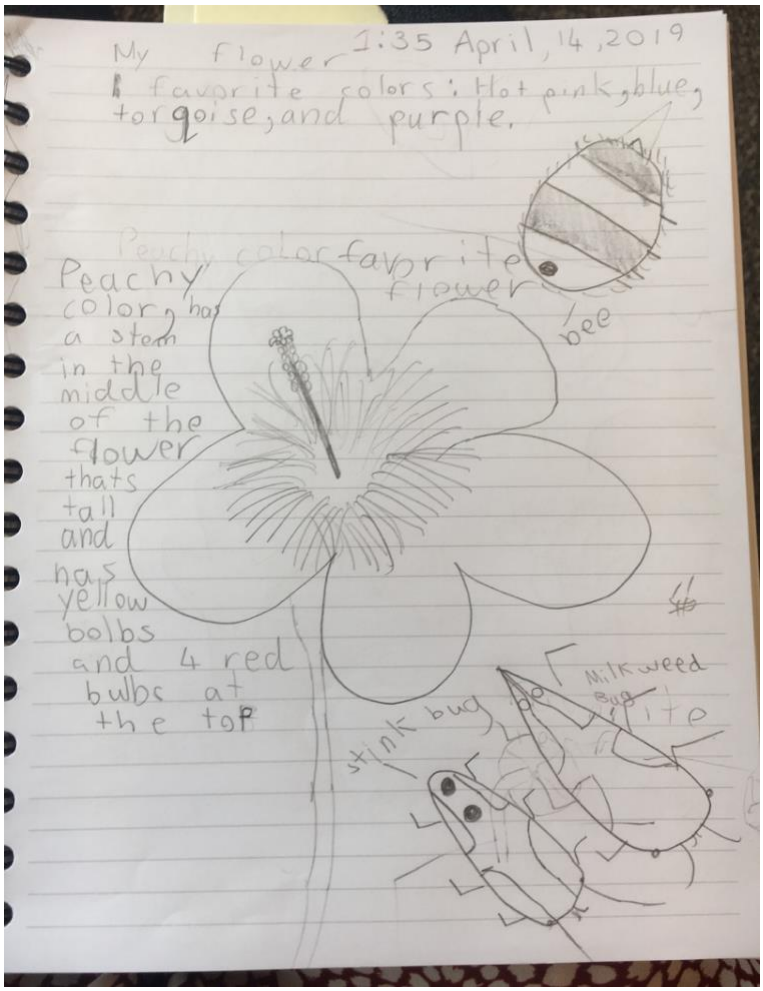
Systems Thinking

Students across all four classes engaged in systems thinking while nature journaling in their school garden. We conceptualized systems thinking as writing about or drawing organisms and relationships through their observations of the garden. The majority of students described only living organisms in the garden, such as leaves, flowers, bees, and birds. The third-grade students most often described and drew leaves and flowers while the sixth-grade students most often described fruit trees and birds. These observations reflect the type of gardens directly outside the classrooms of the different grade levels and the types of prompts provided by their teachers. Third-grade students included details like color, texture, shape, size, smell, leaf veins,

flower petals, and flower reproductive parts in their drawings of leaves and flowers. They often labeled the plants and flowers with the correct common name.

Figure 6

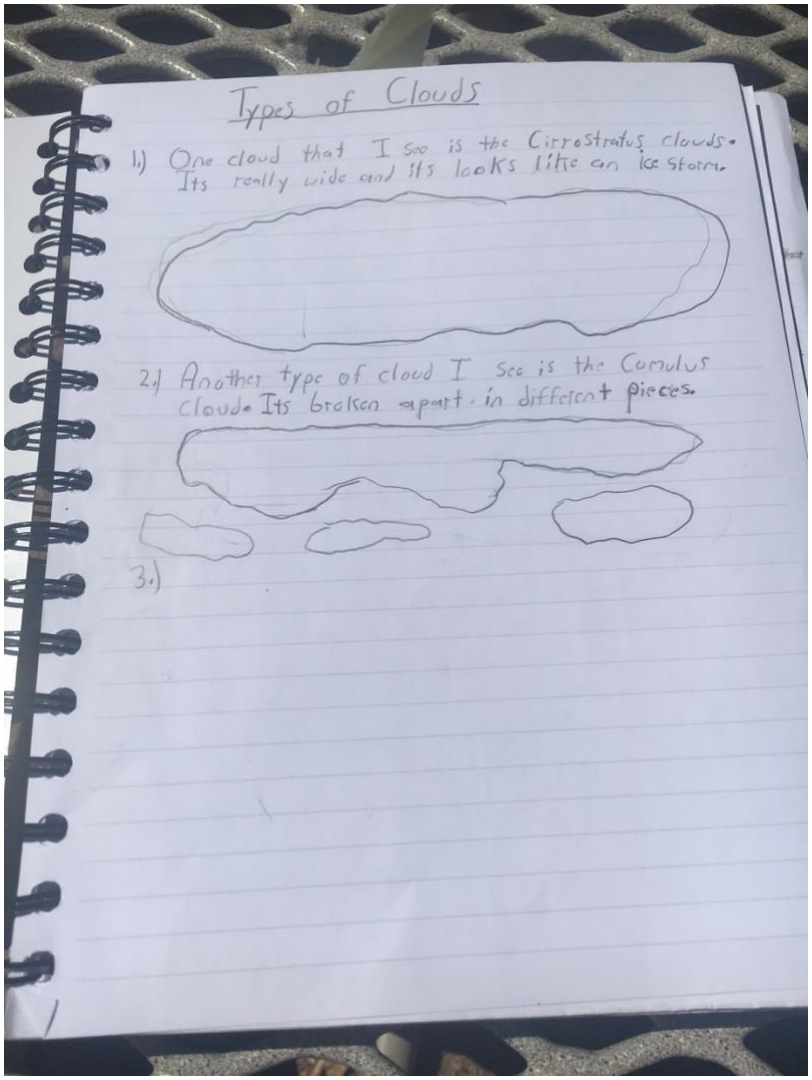
Plant observation



Sixth-grade students included similar organism-level details in their nature journals as the third-grade students. They wrote and drew most often about color, texture, and smell. Unlike the third-grade students, many sixth-grade students wrote about sounds in the garden. Usually they described the sound of birds chirping in nearby trees. One sixth-grade class spent a nature journaling session observing clouds. These students drew what they saw in the sky and identified the type of cloud they saw based on the details from their drawing.

Figure 6

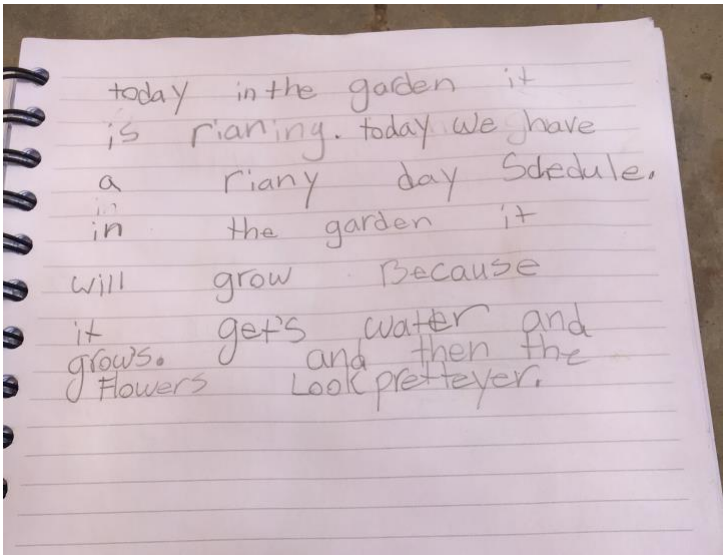
Cloud observation



While many students described and drew static organisms in their nature journals, several students wrote and drew about plant life cycles. Students described leaves changing color and falling and flowers growing and dying. They connected these observations to seasons and weather, such as how rain makes plants grow.

Figure 7

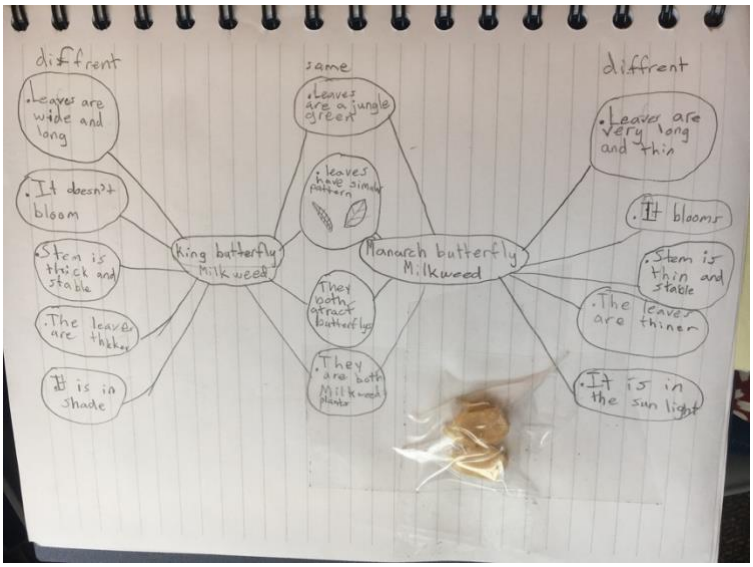
Rain and Plant Relationship

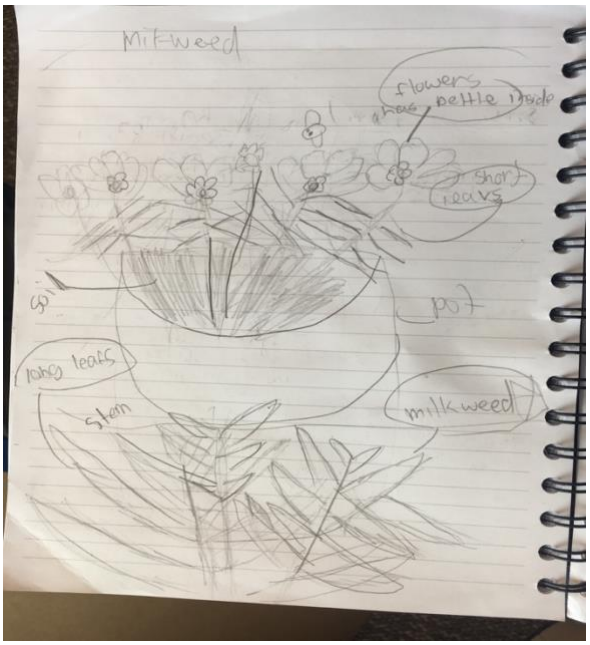


All students wrote or drew about relationships in the garden. Typically, these relationships were between plants and animals. Many third-grade students in one class wrote about the relationship between milkweed and butterflies in response to an outdoor lesson and prompt provided by their teacher. The students drew double-bubble maps to compare and contrast two types of milkweed, with many of the similarities centered around butterfly attraction.

Figure 8

Milkweed Comparison





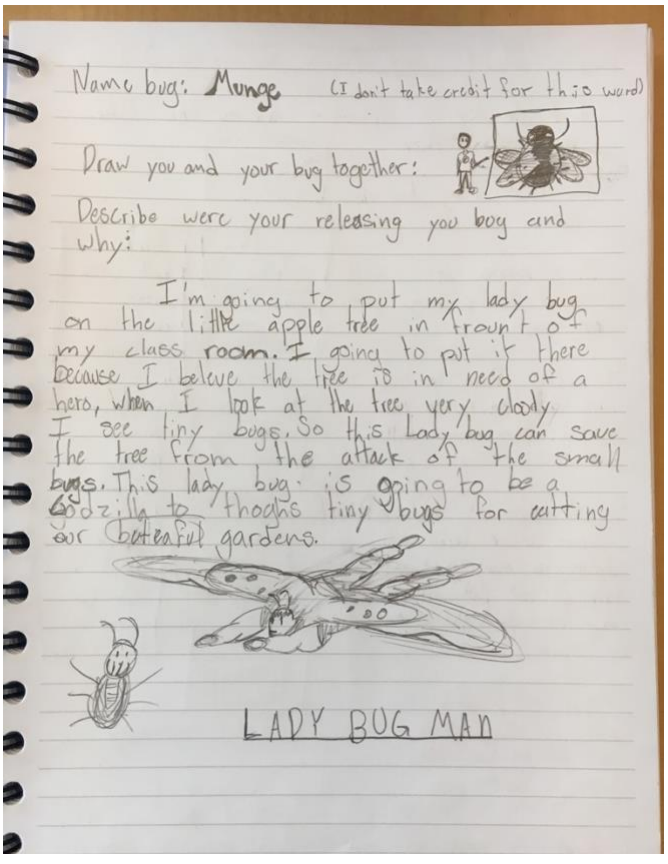
Third-grade students in the other class wrote and drew about bees and insects spending time around flowers. One third-grade student described their observation of a bee:

"I saw a bee on the flower then the bee went to a different flower with the same trick."

Though the student observed pollination, they did not explicitly describe the relationship between bees and plants. One of the sixth-grade classes also participated in a combined outdoor lesson and nature journaling session. Instead of milkweed attracting butterflies, their lesson was about the benefits of ladybugs. Every year the school releases ladybugs into the garden. This was the first year the students were asked to nature journal about the experience. The students were asked to name their ladybug and describe where they wanted to release it and why they chose that location. Many students identified shady places with plants that would be watered often so the ladybug would be able to eat and drink safely. A few students described how ladybugs are natural pesticides, and one student chose a tree in the garden that needed a “hero” to rescue it from the bugs eating the leaves.

Figure 10

Ladybug Man



The students were beginning to identify relationships between plants and animals in the garden. The most explicit instances of students thinking about relationships occurred during interactive lessons with their teachers.

Engaging in systems thinking by writing and drawing about organisms and relationships provided an opportunity for students to learn more, and potentially care more about, their school garden. Next we will discuss instances of students caring about and caring for nature in their nature journals.

Stewardship

Stewardship, caring about and for nature, was most often present in two of the four classes. Stewardship emerged through student responses about caring for nature and environmental storytelling. The third-grade class with students who often described a sense of place also described several instances of care for the garden and nature. Specifically, the fig tree outside their classroom. Many of the students descriptions were in response to Prompt 2 from Class 2 in Figure 3. One student wrote about how they like to care for the fig tree by watering it and another student wrote about how they thought many other people also cared for the fig tree:

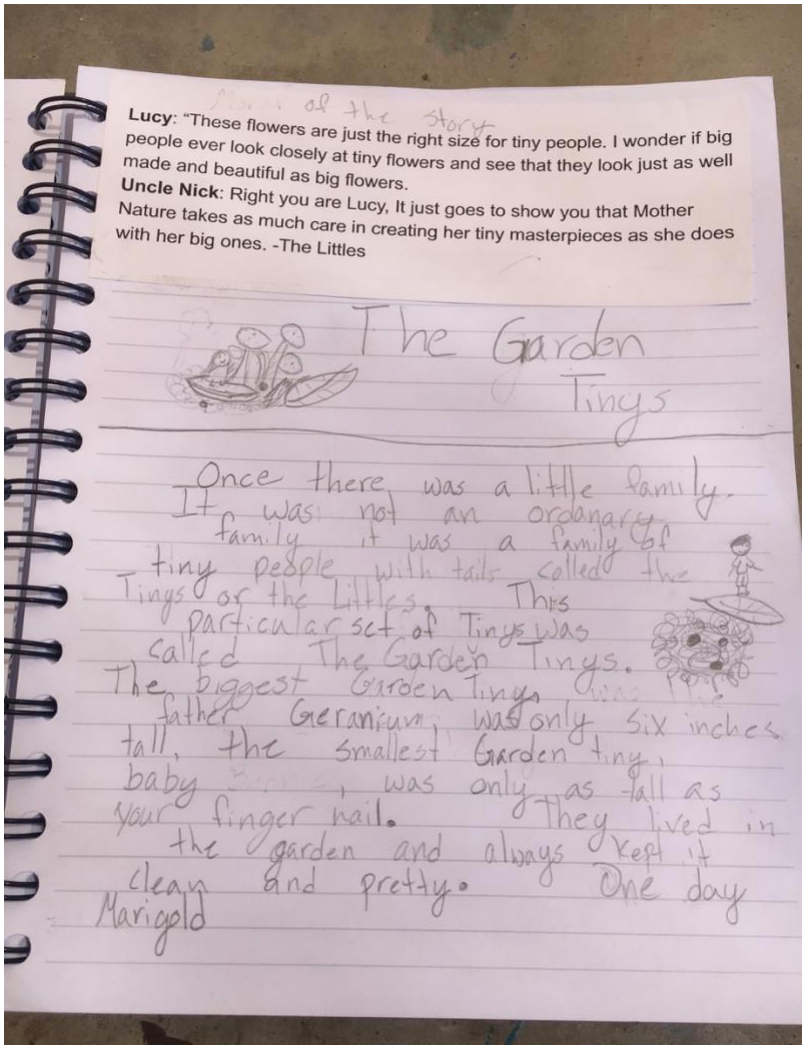
> "I feel like a lot of people don't want the tree to die they want it to live forever. I think that most people love the tree even if it does not have no leafs…"

A few students wrote about caring for the garden through environmentally-focused stories such as "The Garden Tinys" who "always kept it [the garden] pretty and clean," a story about saving the fig tree:

> "...once there was a tree on a school...there was a strong storm and the wind was pulling the tree and it was about to break and the next day the tree fell off and did not like it when it fell so they planted another tree next to a new safe place then another strong storm came and it didn't break."

Figure 11

The Garden Tinys Story



Stewardship was present in many of the responses from students in the sixth-grade class that participated in the ladybug release. When students decided where to release their ladybugs they chose places with access to shade, water, food, and camouflage. One student planned to release their ladybug into the strawberry plants because it was also red and another wanted to release it in the milkweed plants so the ladybugs would eat the aphids that eat the butterfly eggs. These responses show how the students care about and for the plants and animals in their school garden.

Sense of place, an element of sustainability literacy, was present in the interviews and nature journals. Biophilia and positive emotions were also themes that were present in both sets of data. While biophilia and positive emotions were present as place attachment in the interview data, these codes stood on their own in the nature journaling data. Systems thinking was evident in both sets of data, though present much more often in the nature journals. During the interviews students discussed specific plants and animals they noticed, while in nature journals students were able to draw detailed pictures and write about relationships they observed in the garden.

Students described developing a sense of place while nature journaling in their school garden and engaged with three elements of sustainability literacy: importance of local place, systems thinking, and stewardship through writing and drawing in their nature journals. Next, we will discuss how our findings contribute to the field of environmental and sustainability education, relevance to current research, and implications for K-12 educators.

Discussion

Students described developing a sense of place while nature journaling in their school garden. They described experiencing place attachment to the garden through biophilia, emotions, and experiences and place meaning through sensory experiences, noticing details, and systems thinking. Students also engaged in elements of Sustainability Literacy – sense of place, systems thinking, and stewardship – through writing and drawing in their nature journals.

While other nature journaling studies like Warkentin (2011), McMillan and Wilhelm (2007), and Arnold (2012) focus on the perspective of educators facilitating nature journaling with a single class, our study provides the perspective of elementary school students from four different classes and two different grade levels. This is also one of the only studies where nature journaling takes place in a school garden. Other nature journaling studies still take place in natural spaces or on school campuses, but not explicitly in a school garden.

Developing a sense of place was a significant part of students' experiences while nature journaling in their school garden. The students felt very attached to the garden and found meaning in a variety of different ways. Some students described biophilia and positive emotions in how they felt drawn to the beauty of the garden and its bright colors while other students enjoyed observing different types of plants using their senses and noticing how plants and flowers grow and change over time. However the students engaged in developing a sense of place, all students felt a special connection to their school garden that they explored through writing and drawing in their nature journals.

Providing the students with an opportunity to spend time each week in an outdoor space right outside their classrooms helped them feel more attached to the garden and reflect on what it means to them. Nature journaling provided the students time to sit, think, slow down, and capture their thoughts and emotions while spending time in the natural world. Nature journaling is an effective way to help students develop a sense of place — if we want them to care about nature, or even just their school campus, we need to provide time for them to be outside to wonder, observe, and experience the natural world.

While experiencing the natural world through senses and emotions can help students develop a sense of place, engaging in systems thinking can help students become stewards by caring more about and for their garden and nature. NGSS Cross-Cutting Concepts (2013) call for all students to learn about systems, which is especially important for engaging in environmental and sustainability content and action. Third-graders learn that systems are made of component parts that interact with one another and sixth-graders learn that systems are connected to other systems. When students were prompted to write and draw about nature in their school garden they were primarily attuned to individual organisms and noted some simple relationships, but rarely how different parts of the garden system or systems within the garden are connected. The students were not explicitly instructed to look for systems, but they should be attuned to systems from learning in their grade-level courses. The idea that nothing in nature

exists on its own is an integral part of environmental and sustainability learning. Our world is full of complex, dynamic systems.

Perhaps what is more important is the focus on individual organisms instead of the absence of systems thinking in their nature journals. These students spent little time in their garden before participating in the nature journaling initiative. Nature journaling was likely the first time many of the students were prompted to sit, observe, wonder, and draw about what they see, hear, smell, touch, and sometimes taste in the garden. The students were able to notice and capture intricate details of garden organisms that many adults may miss in their own backyards today. With this intimate knowledge of the organisms in the garden, now is an opportune time to build upon their organism-level observations and extend their knowledge to systems. This knowledge may help them to know more about, and hopefully care more about the garden space in which they already feel a strong sense of place.

Limitations

This paper is composed of qualitative data due to the exploratory nature of the study. Mixed-method studies that include student surveys would be a useful next step in understanding the benefits of nature journaling programs. Additionally, we did not collect demographic data on the student participants because our research questions did not focus on demographic characteristics of students. This may limit future questions about student populations that we could answer using this data.

Implications for Educators

The opportunity provided by nature journaling for students to develop a sense of place grounded in the natural world and capacity to become systems thinkers who have a deep understanding of and feelings of connection to the environment should be used by educators to prepare the next generation of sustainability thinkers and problem-solvers. Educators should consider integrating nature journaling into their existing curriculum, leveraging outdoor spaces, and especially school gardens, for engaging with their students in a new way. Nature journaling

may look different in every classroom but can provide students with similar positive experiences of feeling connected to nature in their schoolyard.

Implications for Researchers

Capturing the qualitative experiences of students is a valuable way to understand the effects of new activities and initiatives facilitated in schools. It may seem more straightforward to engage with educators and ask their perceptions of what students are thinking and feeling, but there is no substitute for discussion directly with the students. In future studies on nature journaling, school gardens, or any type of environmental or sustainability-focused research in schools, it would be valuable to consider including the student perspective to explore the holistic impact of the work we are all trying to do to make the world a safer, healthier, and happier place.

Conclusion

Nature journaling in school gardens is a unique way to engage students in the natural world while connecting them to nature and engaging them in environmental and sustainability learning. Through a study with four classes at an elementary school we found that nature journaling in school gardens can help students develop a sense of place and prepare students to become systems thinkers. The positive experiences the students had while nature journaling and how they engaged with sustainability literacy in their nature journals showcase the importance of providing students opportunities to spend time outdoors writing and drawing right outside their classrooms.

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